

PATENT COOPERATION TREATY

Applicant :  
ROBROY INDUSTRIES, INC. :  
  
International Application No. : HIGH TEMPERATURE LINER  
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Pittsburgh, Pennsylvania  
21 June 2004

AMENDMENT UNDER ARTICLE 19

Mail Stop PCT, Attn: ISA/US  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

This letter is submitted in response to the International Search Report (ISR) dated 22 April 2004. In response to the ISR, Applicant submits the accompanying replacement pages 21-30 of the above-identified patent application, which are to be substituted for the original pages 21-30. The replacement pages amend claims 1, 7, 14, 24-30 and 35. Claim 1 now includes the limitations of original claims 7 and 24, and claim dependencies have been amended accordingly. The amendments are supported in the original claims and at paragraphs [0028], [0039] and

<p>"EXPRESS MAIL" mailing label number <u>EL971284883US</u></p> <p>Date of Deposit <u>June 21, 2004</u></p> <p>I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR §1.10 on the date indicated above is addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.</p> <p><u>Ruth A. Walkup</u> (Typed or printed name of person mailing paper or fee)</p> <p><u>Ruth A. Walkup</u> (Signature of person mailing paper or fee)</p>
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[0041] of the specification. Claim 14 has been amended to correct a typographical error. Applicant also submits herewith marked-up copies of the amended pages.

In the International Search Report, the Examiner cited U.S. Patent Nos. 4,785,057; 5,177,137; 5,401,799; 5,511,619; 5,889,102; and 5,900,453 as being particularly relevant to claims in the present application.

As recited in the amended claims, the present invention is directed to an extrudable resin composition that includes a high temperature engineering thermoplastic compounded with an external lubricant and one or more of a reinforcement component, an enhancing filler component and a polymeric lubricant. The extrudable resin composition is thermally stable at temperatures of up to about 427°C and is one or more selected from polyarylketones, chemical resistant polysulfones (PSU), polyphenyl sulfones (PPSu), polyether sulfones (PES), polyolefins and polyarylene sulfides. The external lubricant is one or more selected from fatty acids and their corresponding amides, esters, and salts; organic phosphate esters; and hydrocarbon waxes.

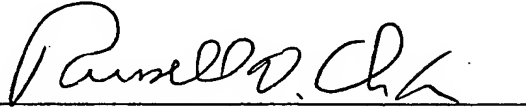
None of the cited prior art, either alone or in combination, discloses or in any way suggests extrudable resin compositions that include a high temperature engineering thermoplastic compounded with an external lubricant and one or more of a reinforcement component, an enhancing filler component, and a polymeric lubricant as is presently claimed.

By the present remarks, Applicant has emphasized the novel features of the compositions of the present invention. Therefore, it is believed that a Written Opinion with a favorable opinion regarding the patentability of claims 1-78 should be issued, and such is respectfully requested.

If there are any questions concerning the Amendment, please contact Applicant's undersigned representative.

Respectfully submitted,

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## THE INVENTION CLAIMED IS

1. An extrudable resin composition, comprising:  
a high temperature engineering thermoplastic compounded with an external lubricant and one or more of a reinforcement component, an enhancing filler component, and a polymeric lubricant, wherein the extrudable resin composition is thermally stable at temperatures of up to about 427°C; wherein the high temperature engineering thermoplastic is one or more selected from the group consisting of polyarylketones, chemical resistant polysulfones (PSU), polyphenyl sulfones (PPSu), polyether sulfones (PES), polyolefins, and polyarylene sulfides; and the external lubricant is one or more selected from the group consisting of fatty acids and their corresponding amides, esters, and salts; organic phosphate esters; and hydrocarbon waxes.
2. The composition of claim 1, wherein the high temperature engineering thermoplastic is present in the extrudable resin composition at a level between about 50 to 99.9 wt. %.
3. The composition of claim 1, wherein the reinforcement component is present in the extrudable resin composition at a level between about 0.1 to 40 wt. %.
4. The composition of claim 1, wherein the enhancing filler component is present in the extrudable resin composition at a level between about 0.01 to 10 wt. %.
5. The composition of claim 1, wherein the polymeric lubricant is present in the extrudable resin composition at a level between about 0.001 to 5 wt. %.
6. The composition of claim 1, wherein the external lubricant is present in the extrudable resin composition at a level between about 0.001 to 2 wt. %.
7. The composition of claim 1, wherein the high temperature engineering thermoplastic is one or more polyarylketones selected from the group consisting of, polyether ether ketones (PEEK), polyether ketones (PEK), and polyether ketone ketones (PEKK).

8. The composition of claim 1, wherein the polyarylene sulfide comprises polyphenylene sulfide (PPS).

9. The composition of claim 7, wherein the polyarylketone comprises polyether ether ketones (PEEK).

10. The composition of claim 7, wherein the polyarylketone comprises polyether ketones (PEK).

11. The composition of claim 7, wherein the polyarylketone comprises polyether ketone ketones (PEKK).

12. The composition of claim 7, wherein the polyarylketone has a melt index (MI) up to about 200 g/10 min. measured at 204°C and 8.4Kg.

13. The composition of claim 8, wherein the polyphenylene sulfide has an MI up to about 200 g/10 min. measured at 320°C and 3.7Kg.

14. The composition of claim 7, wherein the polyarylketone has a 6 minute to 30 minute (6/30) MI ratio of between about 0.1 to 1.

15. The composition of claim 14, wherein the 6/30 MI ratio is close to 1.

16. The composition of claim 8, wherein the polyphenylene sulfide has a 6 minute to 15 minute (6/15) MI ratio of between about 0.1 to 1.

17. The composition of claim 16, wherein the 6/15 ratio is close to 1.

18. The composition of claim 3, wherein the reinforcement component is one or more selected from inorganic fibers, glass fibers, carbon fibers, graphite, ceramic fibers, and polymeric fibers.

19. The composition of claim 18, wherein the inorganic fiber is glass fiber.

20. The composition of claim 4, wherein the enhancing filler component is one or more selected from titanium dioxide, barium sulfate, silica, alumina, talc, mica, kaolin, clay, silica-alumina, calcium carbonate, calcium silicate, calcium phosphate, calcium sulfate, magnesium carbonate, magnesium oxide, zinc oxide, magnesium phosphate, silicon nitride, glass, hydrotalcite, and zirconium oxide.

21. The composition of claim 20, wherein the enhancing filler component is a mineral oxide present between about 15 to 25 wt. %.

22. The composition of claim 5, wherein the polymeric lubricant is a fluoropolymer.

23. The composition of claim 22, wherein the fluoropolymer is a polymer comprising one or more monomers selected from the group consisting of tetrafluoroethylene, trifluoroethylene, vinylidene fluoride, chlorotrifluoroethylene, and fluorinated alkyl esters of (meth)acrylic acid.

24. The composition of claim 6, wherein the external lubricant is present in the extrudable resin composition at a level between about 0.01 to 1.9 wt. %.

25. The composition of claim 1, wherein the fatty acids include one or more selected from the group consisting of myristic acid, palmitic acid, stearic acid, arachic acid, montanic acid, octadecenoic acid, and parinaric acid.

26. The composition of claim 1, wherein the fatty acid esters are selected from fatty acids esterified with one or more hydroxyl containing compounds selected from the group consisting of glycerol, ethylene glycol, propylene glycol, pentaerythritol and C<sub>1</sub> to C<sub>24</sub> alkylols.

27. The composition of claim 1, wherein the fatty acid amides are selected from fatty acids that have undergone an amidation reaction with one or more amine containing

compounds selected from the group consisting of C<sub>1</sub> to C<sub>24</sub> primary amines, C<sub>1</sub> to C<sub>24</sub> secondary amines, methylene bisamines, ethylene bisamines and alkanolamines.

28. The composition of claim 1, wherein the fatty acid amides are one or more selected from palmitic acid amides, stearic acid amides, oleic acid amides, and N,N'-ethylenebisstearamide.

29. The composition of claim 1, wherein the fatty acid salts include one or more fatty acid salts of an ion selected from the group consisting of calcium, magnesium, zinc, and cadmium.

30. The composition of claim 1, wherein the hydrocarbon waxes include one or more selected from the group consisting of paraffin waxes, polyolefin waxes, oxidized polyolefin waxes, and microcrystalline waxes.

31. The composition of claim 1, wherein the high temperature engineering thermoplastic has a heat deflection temperature of at least 121°C.

32. An extrudable resin composition, comprising:  
50 to 99.9 wt. % of a high temperature engineering thermoplastic consisting of one or more polyphenylene sulfides;  
0.1 to 40 wt. % of a reinforcement component consisting of glass fiber;  
0.01 to 10 wt. % of an enhancing filler component consisting of titanium dioxide;  
0.001 to 5 wt. % of a polymeric lubricant consisting of polytetrafluoroethylene; and  
0.001 to 2 wt. % of an external lubricant selected from the group consisting of calcium stearate, zinc stearate, palmitic acid amides, stearic acid amides, oleic acid amides, and N,N'-ethylenebisstearamide, wherein the extrudable resin composition maintains its form and function at temperatures up to about 232°C, and further wherein the high temperature engineering thermoplastic has a heat deflection temperature higher than about 121°C.

33. An extrudable resin composition, comprising:  
50 to 99.9 wt. % of a high temperature engineering thermoplastic consisting of one or more polyphenylene sulfides;

15 to 25 wt. % of an enhancing filler component consisting of mineral oxide;  
0 to 5 wt. % of a polymeric lubricant consisting of polytetrafluoroethylene; and  
0.001 to 2 wt. % of an external lubricant selected from the group consisting of calcium stearate, zinc stearate, palmitic acid amides, stearic acid amides, oleic acid amides, and N,N'-ethylenebisstearamide, wherein the extrudable resin composition maintains its form and function at temperatures up to about 232°C, and further wherein the high temperature engineering thermoplastic has a heat deflection temperature higher than about 121°C.

34. The composition of claim 1, wherein the resin is extruded into a liner for a tubular.

35. In a method of extruding an extrudable resin composition in an extruder, the improvement comprising:

compounding an extrudable resin composition comprising a high temperature engineering thermoplastic with one or more additives selected from the group consisting of a reinforcement component, a polymeric material, an enhancing filler component, a polymeric lubricant component, and an external lubricant component, wherein the additives are uniformly dispersed within the high temperature engineering thermoplastic; and wherein the high temperature engineering thermoplastic comprises one or more selected from the group consisting of polyarylktones, chemical resistant polysulfones (PSU), polyphenyl sulfones (PPSu), polyether sulfones (PES), polyolefins, and polyarylene sulfides; and the external lubricant is one or more selected from the group consisting of fatty acids and their corresponding amides, esters, and salts; organic phosphate esters; and hydrocarbon waxes; and

feeding the extrudable resin composition to an extruder.

36. The method of claim 35, wherein the polymeric material is selected from the group consisting of high temperature engineering thermoplastics, natural and synthetic rubbers, plastics, and silicon-based polymers.

37. The method of claim 35, further comprising forming the extrudable resin composition into substantially cylindrical pellets before feeding the extrudable resin composition to an extruder, wherein the extruder has a vacuum sizer to form a substantially



cylindrical liner, and further wherein the pellets have a diameter between about 1/16" to 1/4" and a length between about 1/16" to 1/4".

38. The method of claim 37, wherein the cylindrical liner is between about 20 to 100 feet in length.

39. The method of claim 38, wherein the cylindrical liner withstands hoop stress of between about 100 to 6,000 psi.

40. A high temperature liner produced according to the method of claim 35.

41. A method of transporting oil or gas in downhole applications, comprising moving the oil or gas through a line pipe, flow line, and transportation line, comprising the high temperature liner of claim 40.

42. A method of transporting oil or gas in downhole applications, comprising moving the oil or gas through a line pipe, flow line, and transportation line, comprising a high temperature liner produced according to the method of claim 35.

43. A liner, comprising a tube having a first end, a second end, and a tube wall, wherein the tube wall extends between the first end and the second end, is substantially cylindrical, and has an outer surface;

the outer surface is smooth or non-smooth; and

the tube is made of a resin composition of high temperature engineering thermoplastic compounded with one or more of a reinforcement component, an enhancing filler component, a polymeric lubricant, and an external lubricant, wherein the composition is thermally stable at a temperature of up to about 427°C.

44. The liner of claim 43, further including a plurality of disruption members attached to the outer surface of the tube wall, said disruption members creating the non-smooth outer surface, wherein the plurality of disruption members is made of the resin composition.

45. The liner of claim 44, wherein each of the disruption members is a tab including a tab wall.

46. The liner of claim 45, wherein a joint formed by the tab wall and the tube wall defines an acute angle with respect to the tube wall.

47. The liner of claim 46, wherein the acute angle is between about 30 and 60 degrees.

48. The liner of claim 47, wherein each tab is attached to the tube wall by sonic welding.

49. The liner of claim 44, wherein each of the disruption members is a rib including opposing rib walls.

50. The liner of claim 49, wherein each rib extends longitudinally of the tube wall.

51. The liner of claim 50, wherein a joint formed by each opposing wall of the rib and the tube wall defines an acute angle with respect to the tube wall.

52. The liner of claim 51, wherein the acute angle is between about 30 and 60 degrees.

53. The liner of claim 52, wherein each rib includes at least one passageway therethrough.

54. The liner of claim 53, wherein the at least one passageway is a rib cut defined in the rib.

55. The liner of claim 54, wherein the rib cut defines an acute angle with respect to the longitudinal axis of the liner.

56. The liner of claim 55, wherein the rib cut is between about 1/64" to 2".

57. The liner of claim 44, wherein each of the disruption members is a groove anchor member comprising a groove having groove walls on either side of the groove, said groove walls being higher than the surface of the liner, said groove anchor member formed by a heat mechanism which melts the liner surface to create the groove anchor member, said heat mechanism selected from the group consisting of knurlers, solder irons, and lasers, and further wherein the groove anchor member forms a surface pattern on the longitudinal axis of the liner.

58. A method of using a tubular, comprising the steps of:  
providing a liner having a plurality of disruption members on an outer surface thereof;  
installing the liner within the tubular; and  
filling an annular gap between the tubular and the liner with a filler material, wherein the filler material flows around the plurality of disruption members and adheres to the plurality of disruption members to aid in preventing the liner from displacing longitudinally from within the tubular, wherein the liner and the plurality of disruption members are made of a resin composition of high temperature engineering thermoplastic compounded with one or more of a reinforcement component, an enhancing filler component, a polymeric lubricant, and an external lubricant, wherein the composition is thermally stable at a temperature of up to about 427°C.

59. The method of claim 58, wherein the annular gap is between about 10 to 80 mils.

60. The method of claim 58, wherein the annular gap is between about 20 to 50 mils.

61. The method of claim 58, wherein the filler material is selected from the group consisting of grout, cement, polymers or blow molding compounds.

62. The method of claim 61, wherein each of the disruption members is a tab including a tab wall.

63. The method of claim 62, wherein a joint formed by each tab wall and the tube wall defines an acute angle with respect to the tube wall.

64. The method of claim 63, wherein the acute angle is between about 30 and 60 degrees.

65. The method of claim 64, wherein each tab is attached to the tube wall by a method selected from the group consisting of sonic welding and adhesive.

66. The method of claim 61, wherein each of the disruption members is a rib including opposing rib walls.

67. The method of claim 66, wherein each rib extends along the longitudinal axis of the tube wall.

68. The method of claim 67, wherein a joint formed by each rib wall and the tube wall defines an acute angle with respect to the tube wall.

69. The method of claim 68, wherein the acute angle is between about 30 and 60 degrees.

70. The method of claim 69, wherein each rib includes at least one passageway therethrough.

71. The method of claim 70, wherein the at least one passageway is a rib cut defined in the rib.

72. The method of claim 71, wherein the rib cut defines an acute angle with respect to the longitudinal axis of the liner.

73. The method of claim 72, wherein the rib cut is between about 1/64" to 2".

74. The method of claim 61, wherein each of the disruption members is a groove anchor member, said groove anchor member created by using a heat mechanism.

75. The method of claim 74, wherein the heat mechanism is selected from the group consisting of solder irons and lasers.

76. The method of claim 58, further comprising transporting oil or gas in downhole applications, comprising moving the oil or gas through a line pipe, flow line, and transportation line, comprising a high temperature liner produced according to the method of claim 35.

77. A method of transporting oil or gas in downhole applications, comprising:  
providing a tubular comprised of a tubular and a liner, wherein the liner is comprised of a high temperature engineering thermoplastic compounded with one or more of a reinforcement component, an enhancing filler component, a polymeric lubricant, and an external lubricant, and further wherein the extrudable resin composition is thermally stable at temperatures of up to about 427°C; and

moving the oil or gas through a line pipe, flow line, and transportation line comprised of the liner.

78. A method of transmitting or storing corrosive fluids in corrosive applications, comprising:

providing a tubular comprised of a tubular and a liner, wherein the liner is comprised of a high temperature engineering thermoplastic compounded with one or more of a reinforcement component, an enhancing filler component, a polymeric lubricant, and an external lubricant, and further wherein the extrudable resin composition is thermally stable at temperatures of up to about 427°C; and

transmitting, storing, and/or thermally insulating the corrosive fluids in the liner;  
wherein the corrosive applications include piping, said piping selected from the group consisting of wastewater treatment, chemical plants, slurry pipes, paper mills, agricultural/biological facilities, and electric power plants.